

# PATENT SPECIFICATION

345,672



Application Date: Dec. 21, 1929. No. 39,142 / 29.

" .. June 30, 1930. No. 19,820/30.

One Complete Left: Sept. 18, 1930.

Complete Accepted: March 28, 1931.

## PROVISIONAL SPECIFICATION.

No. 39,142; A.D. 1929.

### Method of and Means for Detecting Water Vapour.

We, LEONARD ANGELO LEVY, DONALD WILLOUGHBY WEST and ROBERT HENRY DAVIS, British Subjects, all of 187, Westminster Bridge Road, London, S.E. 1, do hereby declare the nature of this invention to be as follows:—

This invention relates to a method of and means for detecting water vapour and has for one object to provide an efficient means whereby it may be ascertained when appliances, intended for the drying of air or gas, have ceased to function satisfactorily. The invention is particularly applicable to drying operations wherein silica-gel is employed for removing water vapour from the air or gas brought into contact therewith.

It is well known that silica-gel is practically similar in appearance when in the hydrated or dehydrated condition and further it is practically impossible by visual examination alone to detect whether such an absorbent is working satisfactorily or otherwise.

A method of detecting water vapour according to this invention consists in combining with an absorbent (for example, silica-gel) a substance capable of giving an indication as to the condition of the absorbent.

Further, according to the invention there is provided an absorbent, such as silica-gel, having combined therewith a substance capable of indicating visually the hydrated and dehydrated conditions of the said absorbent.

In a suitable method of carrying the invention into effect a substance is combined with silica-gel which shows a marked difference in colour between the hydrated and dehydrated conditions thereof so that the silica-gel, prior to being employed for drying purposes has a certain colour, but upon absorption of water vapour the silica-gel assumes a different colour. For example, silica-gel dehydrated after impregnation with dilute cobalt chloride solution gives a sapphire

blue colour, but upon absorption of water vapour by the silica-gel, the colour of the same reverts practically to the natural buff hue of commercial silica-gel, as the hydrated cobalt chloride is of a pale pink colour and almost invisible.

It will be appreciated that the whole of the silica-gel employed for drying need not be treated with an indicating substance in the manner indicated above, but a layer or layers of silica-gel disposed at intervals in the drying circuit may be so treated, means being provided whereby the treated portions of the silica-gel may be observed and a change in colour ascertained.

The indicating substance may be employed for indicating when silica-gel is approximately saturated and may also be employed for indicating when the dehydration of the silica-gel is completed.

In place of the cobalt chloride, substances such as platinocyanides and dehydrated copper sulphate may be employed as indicators for carrying the invention into effect.

It will further be appreciated that the invention is applicable to drying plants for all purposes and is especially applicable for use in respirators for protection against Carbon Monoxide, wherein the inspired air must be freed from moisture to prevent contamination of the catalytic oxydising agent employed. It is known that the life of a respirator is limited by the life of the drying layer and an indication of the approaching exhaustion of the drying layer is afforded by the invention, the indication being given when the appliance is about to become inoperative and thereafter permitting the passage of poisonous Carbon Monoxide.

Dated the 21st day of December, 1929.

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BEST AVAILABLE COPY

## PROVISIONAL SPECIFICATION.

No. 19,820, A.D. 1930.

Method and Means for Detecting Water Vapour in Gases,  
particularly applicable to Respirators.

We, ROBERT HENRY DAVIS, LEONARD ANGELO LEVY, and DONALD WILLOUGHBY WEST, British Subjects, all of 187, Westminster Bridge Road, London, S.E. 1, do hereby declare the nature of this invention to be as follows:—

This invention relates to a method and means for detecting water vapour and more particularly to the detection of the presence of water vapour in air or other gas which has passed through a drying agent.

This invention consists in a method of indicating the presence of water vapour in air or other gas which comprises causing the air or gas or a part thereof to pass into contact with a substance capable of showing a relatively marked change in appearance upon contact with a relatively small quantity of water vapour.

Further, according to this invention there is provided a respirator for use as a protection against carbon monoxide which comprises in combination a container provided with an air inlet, an outlet for permitting air to be drawn through said inlet and container, a layer of a drying agent arranged in the path of said air from the inlet, a substance, capable of showing a relatively marked change in appearance upon contact with a relatively small quantity of water vapour, arranged to receive the whole or part of the air drawn through the drying agent, means whereby the appearance of said substance may be observed and a layer of a catalytic mixture adapted to oxidise carbon monoxide gas arranged to receive the whole of the air which is drawn through the air outlet.

In a suitable arrangement for carrying the method according to this invention into effect a dehydrated substance such for example as cobalt chloride is applied as a coating to granules which are preferably colourless, such for example as purified pumice granules, and the granules thus

coated are arranged in the path of a current of air or other gas which is to be tested for water vapour in such a manner that they are visible to an observer who is thereby enabled to detect any change of colour in the coated granules.

When used in conjunction with a respirator in the manner described above the granules are located in the respirator in the manner indicated above so as to be visible through a window provided in the wall of the container.

When dehydrated cobalt chloride which is blue in colour is used for coating the granules in the manner described the contact of water vapour therewith immediately changes the colour to pink.

It is to be understood that substances other than cobalt chloride may be used such for example as platinocyanide of magnesium and other elements and also salts or substances the colour of which varies with their state of hydration, such change of colour being rapidly effected in the presence of water vapour.

It will be observed that this invention is particularly useful in conjunction with the type of respirator referred to in view of the fact that catalytic oxidising mixtures are only effective as long as they are perfectly dry and thus the life of such a respirator depends upon the life of the drying agent contained within the respirator and as carbon monoxide is a tasteless and odourless gas which has no irritant effect which can be detected by a person breathing the gas it will be appreciated that the provision of means for detecting the exhaustion of the drying agent is an extremely important advance in the construction of such respirators.

Dated the 30th day of June, 1930.

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## COMPLETE SPECIFICATION.

Improvements in and relating to Appliances for Purifying  
Respirable Gases.

We, LEONARD ANGELO LEVY, DONALD WILLOUGHBY WEST and ROBERT HENRY DAVIS, British Subjects, all of 187, Westminster Bridge Road, London, S.E. 1, do

hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the 5 following statement:—

The present invention is for an improved appliance, particularly applicable to respirators, for the absorption of water vapours from respirable gases for the subsequent removal therefrom of noxious components.

For the destruction of such noxious components it is frequently necessary that the gas should be dried. This is the case 10 in the removal by catalytic action of carbon monoxide from air. In order that the catalytic action may be effective, the respirable air must be adequately dried before coming in contact with the catalyst.

Since carbon monoxide is an odourless and tasteless gas, no indication may be given until the appearance of toxic effects of its non-destruction by the catalytic agent. Consequently, it is highly desirable that 15 the agent for dehydrating the gas to be purified from this and like poisonous components should be known to be working effectively, and that the approach to saturation point of said agent should be recognisable.

As is well known, certain solid drying agents such as silica gel are practically similar in appearance in the hydrated and the unhydrated condition, and so it is 20 virtually impossible by visual examination alone to detect whether the agent has been saturated or not.

Now according to this invention an appliance for drying respirable gases for 25 the subsequent removal therefrom of noxious components is characterised by a container having disposed in the path of the entrant air a charge comprised of a moisture-absorbent mass, a chemical 30 reagent which undergoes a colour change on contact with moisture (for example, a dehydrated metallic salt of different colour in the hydrated and unhydrated conditions) positioned on the opposite side 35 of the moisture-absorbent mass to the gas inlet and an agent for removing the noxious component disposed, with relation to the moisture absorbent mass, beyond such colour-change indicator.

More specifically, the invention comprises an appliance for drying air for subsequent removal therefrom in the appliance of noxious components consisting of 40 a container having a charge comprised of a moisture-absorbent mass of silica gel in continuity at a region remote from the gas inlet with a colour change indicator of the type aforesaid, and an agent disposed beyond such indicator for removing the 45 noxious components.

The whole of the moisture-absorbent may be impregnated with said colour change reagent, or may be composed of at least two zones, one alone of which is so impregnated and is of sufficient substance or depth to provide by the colour change adequate warning of the commencement of exhaustion of the absorbent-proper.

Where the whole of the moisture absorbent-proper is impregnated with the reagent, a safety mark may be, and preferably is, disposed relatively to the absorbent mass in order to give adequate warning of the approach of exhaustion of 70 the main mass of absorbent.

A special feature of this invention consists in a respirator for protection against carbon monoxide, which comprises, in combination, a container having air inlets and outlets, a mass of moisture-absorbent disposed in the path of the entrant air, a layer of an agent of the type aforesaid likewise disposed so as to be in the path of the entrant air, and, for destroying the 75 carbon monoxide, a catalytic mass so disposed as to intercept the whole of the air arriving through the main absorbent and the colour change indicator.

Said indicator may be advantageously 80 employed distributed upon a carrier, which may be of the same material as that which provides the moisture-absorbent proper, the so impregnated carrier so constituting a form of auxiliary moisture-absorbent, although it must be understood that according to this invention the reagent used to indicate the presence of 85 moisture is in no way used as an absorbent.

The reagent to show the presence of moisture may be a metallic salt, such as a salt of cobalt or copper, which shows distinctive colours in the hydrated and unhydrated condition. For example, the 90 colour change indicator may be constituted by a mass of silica gel which has been dehydrated after impregnation with a dilute aqueous solution of cobalt chloride. Such dehydrated mass is of a sapphire-blue 95 colour, but upon absorption of water the colour reverts immediately to the natural buff hue of commercial silica gel, because the colour of the hydrated salt is of a pale pink and hence almost invisible. It follows that the beginning of the 100 absorption of colour from the colour change agent will provide warning that the absorbent-proper is becoming saturated and, therefore, approaching exhaustion. In the preferred construction according to this invention, therefore, the colour change indicator is embodied or 105 associated with a moisture-absorbent mass so that there may still be a measure of 110 115 120 125 130

protection after the colour change has shown the exhaustion of the moisture-absorbent proper.

If desired, layers of the colour indicator may be disposed at intervals in the drying circuit, means being provided throughout the whole length of the indicator material whereby the whole of the absorbent mass may be observed.

It will be appreciated that the position of the colour change indicator in relation to the absorbent proper determines the moment at which indication is given as to the condition of the said absorbent, and if the portion of the colour change indicator under observation be of sufficiently large area and said indicator be disposed between two layers of the main moisture-absorbent, ample warning will be given to the user of the degree of efficiency of the respirator.

In place of a cobalt salt, substances such as dehydrated double platinocyanides, or a salt of copper, such as copper sulphate, may be employed as the colour change indicator.

As stated, the carrier for the colour change indicator need not be of the same material as constitutes the moisture-absorbent proper. For example, purified pumice granules may be impregnated with the solution of a cobalt salt, the mass dehydrated, and then used to constitute the indicator layer or mass.

One preferred construction according to the invention is illustrated in the accompanying Drawings, wherein:

Figure 1 is a front elevation of a respirator canister according to the invention, and

Figure 2 is a section on the line 2—2 of Figure 1.

The Drawings illustrate a canister for a respirator for protection against carbon monoxide, which comprises a container 1 having an air inlet 2, and an air outlet 3 for connection to the mouthpiece of the respirator. A layer of moisture-absorbent 4, such as silica gel, is disposed adjacent to the air inlet 2 and is separated, by means of a gauze screen 5, from a layer of colour change indicator 6, for example, pumice granules impregnated as aforesaid, separated from a third layer of an oxidising catalytic agent 7 by a gauze screen 8. For observation, the side of the canister has a window 9.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:

1. An appliance for drying respirable gases for the subsequent removal therefrom of noxious components, characterised by a container having disposed in the path of the entrant air a charge comprised of a moisture-absorbent mass, a chemical reagent which undergoes a colour change on contact with moisture (for example, a dehydrated metallic salt of different colour in the hydrated and unhydrated conditions) positioned on the opposite side of the moisture absorbent mass to the gas inlet and an agent for removing the noxious component disposed, with relation to the moisture absorbent mass, beyond such colour-change indicator.

2. A modification of an appliance according to Claim 1 wherein the colour change indicator is embodied with the moisture-absorbent proper, either throughout the mass thereof or in a region remote from the gas inlet.

3. An appliance according to Claim No. 2 wherein the colour-change indicator is embodied in the whole mass of the absorbent proper characterised by a safety-mark so disposed relatively to the moisture-absorbent mass as to give warning of the approach of exhaustion of the main mass of absorbent.

4. An appliance according to Claim No. 1 characterised in this that the colour-change indicator constitutes a distinct charge from the charge of moisture-absorbent proper, for example, consists of a carrier composed of material identical with or different from the material forming the moisture-absorbent proper, upon which is distributed said colour-change indicator.

5. An appliance according to the preceding Claim No. 4 characterised by a charge of colour-change indicator composed of an inert porous solid, for example, pumice granules, impregnated with a colour-change indicator, for example, a dehydrated salt of copper or cobalt.

6. An improved appliance for the absorption of water vapour from respirable gases substantially as hereinbefore described, and as shown in the accompanying drawings.

Dated this 13th day of September, 1930.  
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Fig.1.

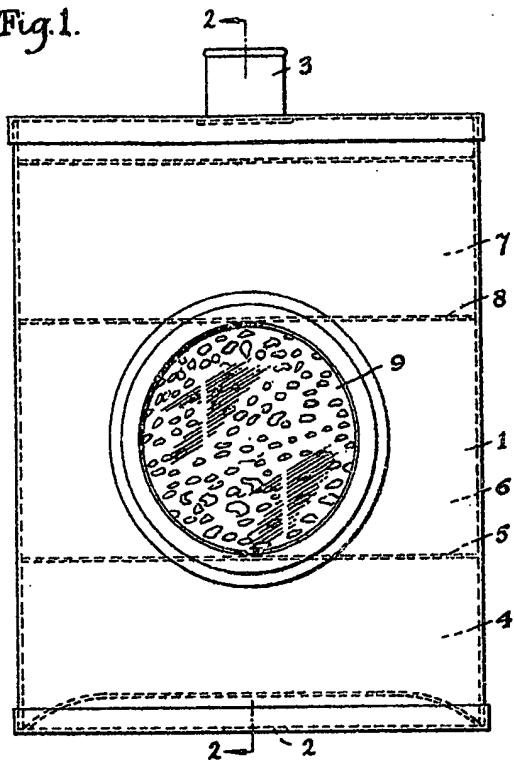
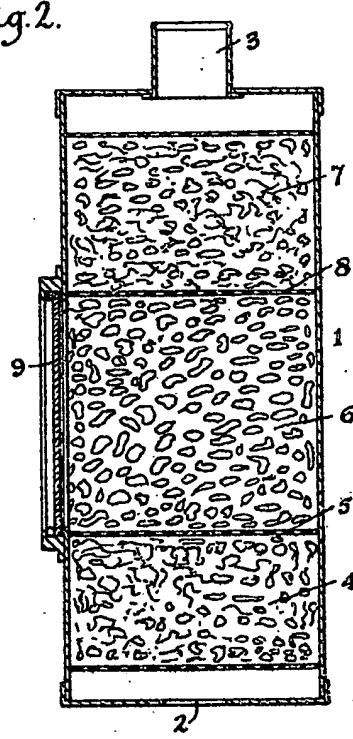


Fig.2.



*[This Drawing is a reproduction of the Original on a reduced scale.]*